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# Steps towards an ecology of money infrastructures: materiality and cultures of Ripple

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**ABSTRACT**

Money's materiality produces an ontological conundrum for social theory: should the analysis of money foreground the objects used as money, or the abstract relations that underpin it? Provoked by the emergence of cryptocurrencies, this paper develops a conceptualization of money as a technological and social infrastructure which directly addresses this theoretical impasse. Cryptocurrencies' sole form of material existence coincides with their underpinning infrastructure of records, accounting and payments. In the past decade, cryptocurrencies have skyrocketed in number, and they have been applied to a host of use cases. This paper focuses on cross-border payments through the example of the fintech company Ripple, the cryptocurrency XRP, and the design of the XRP Ledger. Combining literatures from the social theory of money, science and technology studies and new materialisms, this article develops steps towards an ecological conceptualization of money infrastructures. Infrastructures, understood ecologically, include devices, active forms, and imaginaries in seamless webs of mutual relations of co-evolution. These ecologies are always potentially prone to slippage, dissolution, disassembling, reassembling and reappropriation, dependence, and competition.

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## Introduction

Cryptocurrencies are digital means of payment that operate on the infrastructure of distributed ledger technologies (DLT), or blockchains (Rella 2020). DLTs are databases distributed on all the machines running the necessary software, sometimes called miners, nodes, validators, authorities, etc. Distributed ledgers record the transactions intervening in a network, and they are updated through consensus algorithms, whereby the validating nodes agree on rules and procedures as to which transactions are deemed legitimate and should, therefore, be added as 'blocks' in the blockchain (Werbach 2018). The first example of a blockchain-based cryptocurrency, Bitcoin, applied this technology to record transactions and issue new tokens acting as means of payment, unit of account, and store of value without any centralized third party (Nakamoto et al. 2019). Bitcoin prevents double spending – the fraudulent multiple use of the same sum of money – by synchronizing the different copies of the blockchain stored in the full nodes in the network, and by rewarding validating nodes (called 'miners') with newly issued Bitcoins.

In the ten years after Bitcoin's emergence, cryptocurrencies have skyrocketed in number, and they have been the object of growing academic and popular attention. At the time of writing, more than

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2200 currencies and tokens are exchanged in hundreds of online exchanges, with a total market capitalization of US$ 268 billion (CoinMarketCap 2019a). Blockchain and DLT have also been applied to a host of use cases, including logistics, the internet of things, land and property, healthcare, supply chain management, and finance (DuPont 2019). Due to the expansion in the number of use cases, 'cryptocurrencies' are often called 'cyrptoassets', to reflect the diversity of value propositions (Burniske and Tatar 2018).

Among financial applications, cross-border payments are a particularly important field for blockchain experimentation (Mills et al. 2016, Rella 2019). While domestic payments have improved in recent decades in terms of speed and liquidity requirements, the infrastructure for multi-currency and cross-border value transfer is slower and outdated (Rambure and Nacamuli 2008, McKinsey 2015). Cross-border payment messages are routed through the Society for Worldwide Interbank Financial Telecommunications (SWIFT), a financial messaging consortium which has been in operation since the 1970s. Clearing and settlement, furthermore, involve a plethora of intermediaries such as correspondent banking or Nostro-Vostro accounts (CPMI 2016), the Foreign Exchange (FX) market, and intersections between domestic clearing and settlement infrastructures (Scott and Zachariadis 2013, Dörry et al. 2018). It perhaps no surprise, then, that both SWIFT and CLS Bank (the FX clearing and settlement facility) are presently experimenting with blockchain (Allison 2018). DTLs promise double spending prevention and payment automation, or Straight-Through Processing, by creating common ledgers shared by financial institutions in multiple jurisdictions (CPMI 2017). The case study that will animate this paper is the fintech company Ripple, which applies blockchain technologies to cross-border payments through the XRP Ledger and the Interledger Protocol (ILP).

In the past ten years, the social sciences have mainly understood cryptocurrencies as radically new money forms (Bjerg 2015, Coeckelbergh et al. 2018, Hayes 2019) requiring new epistemological tools (Swan and de Filippi 2017). In contrast, this paper takes the emergence of cryptocurrencies and DLT as a provocation to take seriously the infrastructural materiality that underpins all money forms (Maurer 2017). This conceptual move is particularly pertinent to cryptocurrencies, in that the sole form of material existence of these digital assets coincides with their underpinning infrastructure of records, accounting, and payment. Rather than being radically new, cryptocurrencies remind us that every money form requires an underpinning material and technological infrastructure to function.

This paper brings wide-ranging debates on infrastructure in science and technology studies (STS) and new materialisms to bear on questions about money's infrastructural materiality. Specifically, the paper will develop insights from Susan Leigh Star (1999) and Keller Easterling (2014) to take steps towards a conceptualization of money infrastructures as ecologies of material active forms, cultures, and imaginaries that, together, shape money's dispositions and co-evolve in response to both internal and external stimuli. The paper will address the ontological conundrum and resulting theoretical impasse that money's materiality has long posed for social scientists: *should the analysis of money foreground the objects used as money, or the abstract relations that underpin it?*

Cross-border payments are a particularly apposite illustration of money as technological and social infrastructure precisely because they are comparatively less 'infrastructured' than domestic payments. Hence, the dynamics at play in the design and deployment of money infrastructures can be observed with greater clarity. The cross-border payments company Ripple provides an especially illustrative case study, assembled through in-depth interviews, online archival research, and online ethnography. Ripple is a fintech company, which collaborates with over 200 financial institutions, including large banks, payment providers, and some central banks. Ripple, or XRP, is also a cryptoasset, and the XRP Ledger is its underpinning DLT. At the time of writing, XRP is the third highest cryptoasset by market capitalization, with a market price of $ 0.3 per XRP and a total market capitalization of $18 billion (CoinMarketCap 2019b). The operations of Ripple and the design of the XRP Ledger have performed and enabled different infrastructural money cultures and practices over time. Hence, Ripple illustrates the ecologic co-evolution of infrastructural money forms and money cultures that this paper sets out to conceptualize and emphasize.

The next section conceptualizes money's materiality as infrastructural, to overcome the impasse between commodity and claim theories of money. It also takes insights from the broader body of infrastructure theory to develop an ecological understanding of money as technological and social infrastructure. The third section teases out the relevant empirical insights from the Ripple case study that allow us to see how different money forms and money cultures can inhabit and co-evolve. The fourth section offers a concluding summary.

## The infrastructural materiality of money

Money's materiality represents a conundrum for social theory. Money is understood as either a commodity which stems from the free exchange of barter, or as the social relations of credit and debt denominated in an abstract and immaterial money of account (Ingham 2005). Those who argue that money emerges out of barter foreground money's *thingness* and derive money's inherent value from that. Conversely, those who conceptualize money as an always already abstract relation of credit tend to downplay money's materiality altogether, and to derive value from accounting, power, and trust. If money's thingness makes it the God of commodities (Marx 1971, p. 125), money's abstraction makes it the Memory Bank (Hart 2000, cf. O'Dwyer 2019).

Yet, as Maurer (2017) has it, money's matter matters beyond money's thingness. For money to work as a memory bank, it requires an infrastructure which stores that memory. That infrastructure of accounting also records and recognizes money objects as money, turning them into monetary commodities. In the case of cryptocurrencies, the money form coincides with its underpinning infrastructure, or, as Swartz (2018, p. 632) has it, 'While Bitcoins operate like nuggets of digital gold, they are only able to do so because they are "records" in the blockchain.'

This paper argues that payment infrastructures are the *loci* through which money's materiality, abstraction, universality, and cultural specificity play out. 'Study a city and neglect its sewers and power supplies' Star (1999, p. 379) argues, 'and you miss essential aspects of distributional justice and planning power'. Desan (2017, p. 111) hints at a similar endeavour when she claims:

> Money has an internal design: societies produce it by structuring claims of value in ways that make those claims commensurable, transferable, and available for certain private as well as public uses. That architecture, in all its intricacy, determines the way money works in the world.

This paper does not aim to settle the question of 'what is money?' once and for all. Rather, it operates an 'infrastructural inversion' vis-á-vis extant social theories of money (Bowker and Star 2000, p. 34) by foregrounding the interdependency between the materiality of money infrastructures, on one side, and the cultures and imaginaries that they mobilize (Faria 2019), on the other, in shaping money in use (see Dodd 1994).

Money understood as an infrastructure stands for the 'record of all manner of relationships of credit and debt across time and space […] all the systems for transferring money, recording those transfers, and creating great globally expansive ledgers' (Maurer 2017, p. 111). They include 'multilateral systems among participating institutions, including the operator of the system, used for to clear, settle, and record payments, securities, derivatives, or other financial transactions' (BIS and IOSCO 2012, p. 7). This paper broadens this definition to include informal and alternative monetary systems, such as cryptocurrencies and mutual credit networks (Amato and Fantacci 2018).

Moreover, 'infrastructure' is itself peculiarly hard to define. For Bowker et al. (2009, p. 97), 'infrastructure evokes vast sets of collective equipment necessary to human activities, such as buildings, roads, bridges, rail tracks, channels, ports, and communications networks […] protocols, […] standards, and memory'. The use of the word *evoke* is not casual: infrastructures are not defined through a list of characteristics but through their role of background and substratum for the circulation of objects, people, and information. For Star and Ruhleder (1996, p. 112), the right question is not '*what* is infrastructure?', but '*when* is infrastructure?' – it is precisely its invisibility and 'taken-for-grantedness' that makes infrastructure hard to specify.

In investigating money's infrastructural materiality, then, the present wide-ranging social science literature on infrastructure guides the inquiry in three directions. First, infrastructures need to be made visible, and the politics inscribed in their design should be open to scrutiny (Winner 1980). More specifically, Keller Easterling's conceptual vocabulary of active forms and dispositions provides particular critical purchase for unpacking the material and immaterial dimensions of money infrastructures. Disposition stands for a 'relationship between potentials. It describes a tendency, activity, faculty, or property in either beings or objects—a propensity within a context' (Easterling 2014, p. 71). In turn, 'Active forms are markers of disposition, and disposition is the character of an organization that results from the circulation of these active forms within it' (p. 72). This allows us to go beyond a purely metaphorical appreciation of the materiality of money infrastructures and to apprehend money's internal design in its own terms.

Second, infrastructures are always already cultural and symbolic artefacts animated by cultures and promises associated with their use (Larkin 2013). Active forms are not limited to material devices: 'stories […] however immaterial, are powerful enough to buckle concrete or bend steel, and they can maintain an inescapable grip on the disposition of infrastructure space' (Easterling 2014, p. 137). Stories also resonate with conceptualizations of imaginaries – or *imaginaire* – and money cultures. As Bátiz-Lazo et al. (2014, p. 105) have it, 'the *imaginaire* is an imagined new social order understood as the natural result of adopting an emerging, unproven technology'.

Similarily to Zelizer's and Dodd's conceptualization of money culture as 'a set of interpretative techniques sensitive to how money is perceived [and] to the range of dispositions and expectations which inform how it is used' (Dodd 1994, p. 58, cf. Zelizer 1994), the *imaginaire* articulates identities, frames expectations, and distributes resources, power, and influence (Flichy 2008). The *imaginaire* is not only a rational expectation: it always entails enchantments and affects (Harvey and Knox 2012). Imaginaries are plural, and their interplay distributes resources and power, and shape subjectivities of people interacting with money infrastructures (Allen and Pryke 1999). Infrastructures are always 'infrastructures of participation', i.e. arenas of interaction between diverse participatory cultures that shape infrastructures' disposition (Beer 2013). Money cultures and imaginaries and the materiality of money infrastructure co-determine money's 'internal design,' and one cannot be fully grasped without the other.

Lastly, infrastructures' apparent fixity needs to be questioned, to foreground their malleability and liveliness (Harvey and Knox 2008, Amin 2014). Susan Leigh Star productively deployed the concept of 'ecology' to embrace the dynamic evolution of infrastructures' materiality and imaginaries. Like the concept of 'networks,' Star's concept of ecology refuses social/natural or social/technical dichotomies (Star 1995, p. 2). The concept of ecology also rejects biological or functionalist metaphors of harmonic balance and orderly internal competition, associated with the concept of 'ecosystem' (Holmes 2009, Hörl and Burton 2017). Compared with the concept of network, however, ecologies can better attend to the seamlessness of social relations, beyond the network metaphors of extension and reach, connectivity and disconnection. As Star (1995, p. 27) has it: 'a web is composed of filaments, and a seamless web should be an oxymoronic term.'

Conceptualized ecologically, money infrastructures and their active forms are understood as dynamically evolving battlegrounds between money cultures and imaginaries. Ecologies attend to the political import of material active forms and 'immaterial' imaginaries, and their real distributive results in terms of power and resources. Ecologies are the painstaking partial equilibria between dependent and competing elements (Bateson 2000). Enrolment in an infrastructure entails failure, power, and the destruction and reworking of the world of the non-enrolled. The next section assembles Ripple as the point of overlap, friction, and co-evolution of multiple active forms and imaginaries.

## Ripple

This section provides a genealogy of Ripple, and it clarifies Ripple's terminology. The term 'Ripple', in fact, is used interchangeably to refer to a pre-blockchain payment system, a fintech company, and

a distributed ledger. This genealogy disentangles this ambiguity, and it provides the basis for the subsequent analysis of the active forms, dispositions, cultures, and their ecological co-evolution.

Ripple is a multi-currency payment system initially designed in 2004 that did not rely on a distributed ledger (Fugger 2004). It is a peer-to-peer mutual credit network that represents money as credit-based trust lines. Participants create money by issuing credit or 'trusting each other', and they destroy money by settling their open accounts. Ripple routes payments from payer to payee through chains of mutually trusting intermediaries, similarly to packet switching and routing over the Internet (Flichy 2008). Ripple went live in 2007 (RipplePay 2018), but it never expanded beyond the first group of users. In 2011, Ripple's designer Ryan Fugger and others launched Villages.io, which implements a worldwide time bank on RipplePay (Villages.io 2017). In January 2011, Fugger added Bitcoin on RipplePay.

Ripple is also the name of the company that acquired the Ripple project from Ryan Fugger. In 2012, in fact, Fugger ceded the right to the name Ripple to the start-up OpenCoin, which changed its name into Ripple Labs in 2013, and into Ripple in 2015. In 2013, the founders of Ripple developed the Ripple Ledger. This Ledger combined Fugger's credit network with a distributed currency exchange, a blockchain-like distributed ledger, and a cryptocurrency called Ripple or XRP. In 2015, Ripple pivoted towards interbank cross-border payment services for financial institutions.

Even if the company Ripple developed the Ripple Ledger, the two remain conceptually separate. The Ledger is permissionless: everyone can open an account, send and receive money, and validate transactions. At the same time, some of Ripple's software solutions operate on the Ripple Ledger, and the company owns a significant amount of the cryptoasset XRP. When the Ledger went live, the company Ripple was endowed 80 of the total 100 billion XRP that was mined, and the developers received the other 20. However, the company does not, strictly speaking, 'own' the Ledger. For clarity, this article will use 'RipplePay' for the original payment system designed by Fugger, 'Ripple' for the company that acquired it in 2012, 'XRP Ledger' for the distributed ledger, and 'XRP' for the cryptoasset operating on the XRP Ledger. The following subsections analyze, respectively, the materiality, cultures, and evolution of the XRP Ledger.

## Design and dispositions

This section disentangles the active forms populating the XRP Ledger, and the dispositions they trigger and disable through their interactions. The materiality of the XRP Ledger combines four active forms: trust lines, the XRP cryptoasset, the consensus algorithm, and the distributed exchange (XRP Ledger Project 2019).

The first active form is the trust line, which derives from the mutual credit network designed by Ryan Fugger. This active form predates Bitcoin and blockchain technologies, and it embodies a radically different conceptualization of money. While Bitcoin manages a network without the need for trust in a centralized third party (Werbach 2018, Swan et al. 2019), trust lines build a network with trust as its co-ordinating principle (Fugger 2004, 2006). Trust lines take inspiration from Local Exchange Trading Systems (LETS), time banks, and hawalas, and it combines them with the Internet concept of packet switching (Flichy 2008). Hawalas are credit networks without central accounting, in which members, or hawaladars, keep separate books of the bilateral credit-debt relations they entertain with each other (Martin 2009, Vlcek 2010). Amato and Fantacci (2018, p. 11) define LETS and time banks thusly:

> A central counterpart keeps account of the exchanges between participants; participants benefit of an overdraft facility that allows each of them to buy before having started to sell; balances are kept in an internal unit of account and are not convertible in official money; the unit of account is normally pegged to the official currency at a fixed rate, but it can also be linked to the time required to offer a given good or service, as in time banks.

Each user, represented on the Ledger as an address, can issue money in any currency by extending trust to another address. The Ledger records all trust lines set up in the network, and it routes

payments across trust lines from a sender to a receiver. When the two addresses are connected by an uninterrupted chain of mutually trusting intermediaries, the payment 'ripples' successfully to its destination. Otherwise, the payment is routed through the distributed FX marketplace described below. Trust lines can be frozen in the case of fraudulent behaviour, and an address can prevent payments from rippling through specific trust lines.

The second active form is the cryptoasset XRP. If trust lines represent money as credit-debt based on trust, XRP is a radical form of commodity money. As a 2013 marketing brochure has it, XRP is 'like gold in your hands'[1], and it is designed to be the most liquid of assets on the XRP Ledger. XRP is an asset that is no-one's liability: no one issued it, no one can freeze it, and it can be sent from any address to any other. Unlike Bitcoin, XRP is 'pre-mined': all 100 billion XRP was created in one instance when the XRP Ledger went live in 2013, and one can only own XRP by buying or receiving it. To limit the number of addresses and trust lines that people can open, each address needs at least 20 XRP, plus 5 per each additional trust line and currency exchange offer. Furthermore, each transaction burns a fraction of XRP to prevent Distributed Denial of Service (DoS) attacks.

The third active form is the network of validators that govern the XRP Ledger's consensus algorithm (Cawrey 2014, Schwartz et al. 2014, Chase and MacBrough 2018). Each validator votes on which transactions to add to the Ledger, and on amendments to the code. The network only adopts the amendments and features that command and maintain a majority among validators. Validators vote in rounds: each round, a validator adapts its vote to the one expressed by a supermajority of other trusted validators, included in a Unique Node List (UNL). The UNL prevents the network from splitting or forking into clusters of validators that systematically validate different sets of transactions. To assure this consistency, Ripple itself runs many nodes, and it strongly suggests an 'official' UNL that other validators should adopt. The UNL makes the XRP Ledger de facto permissioned, in that any validator outside the recommended UNL is not taken into consideration for validation (Rauchs et al. 2018).

The fourth and last active form is the distributed currency exchange. Each address operated by FX liquidity providers and market makers can publish offers to convert trust lines denominated in any currency into any other currency. They can also publish offers to currencies with XRP and vice versa. When a payment requires a currency exchange, or when there are no uninterrupted chains of intermediaries from sender to receiver, the Ledger calculates the most efficient path across the distributed exchange, by ordering them according to exchange rates and transaction fees. Through a feature called 'autobridging,' the system automatically includes any offer to exchange either the sending or the receiving currency with XRP, to see whether than path provides a more favourable exchange rate. For example, a payment sent from dollars to pounds could be routed through two separate offers to exchange dollars with XRP and XRP with pounds, if that provided lower costs and fees.

The XRP Ledger is a web of different active forms influencing each other. Trust lines and the distributed exchange are rhizomatic multipliers in that they 'ceaselessly establish connections' (Deleuze and Guattari 1987, p. 7, Vlcek 2010, p. 433) through their constant proliferation (Easterling 2014, pp. 75-76). The cryptoasset XRP acts as a switch on trust lines by limiting their proliferation (Easterling 2014, p. 77), in that any address must hold reserves in XRP to function and to issue trust lines and offers. The consensus algorithm and the validators determine the terms of trade between active forms: in Easterling's (2014, pp. 78-80) words, they are the governor of the infrastructure. The Ledger's overall disposition is influenced by which amendments are adopted by validators, and by which transactions are validated. The company Ripple, while being independent of the XRP Ledger, has authority over the consensus algorithm through their validators, and through the official Unique Node List, they propose. Ripple also exerts an indirect influence on the Ledger's disposition through the XRP it still owns.

In addition to each active form's properties, they entail and perform specific money cultures and imaginaries, as the next section illustrates. The interplay between active forms and imaginaries determine the overall dispositions of the XRP Ledger. This interplay is not merely technical, but power- and conflict-ridden, as the last sub-section discusses.

## Cultures and imaginaries: trust, liquidity, logistics

This section analyzes the cultures and imaginaries associated with the use of the XRP Ledger, and their influence on the Ledger's overall disposition. The heterogeneity of active forms populating the XRP Ledger is mirrored by a multiplicity of imaginaries and money cultures. These imaginaries foreground different concerns with money's design and social functions: in particular, they give prominence, respectively, to trust, liquidity, and logistics.

The first money culture underpins RipplePay's mutual credit network. Inspired by heterodox economists such as Buckminster Fuller, Bernard Lietaer, and Michael Linton[2], this culture foregrounds trust, distributional fairness, and mutualism. As Amato and Fantacci (2018, p. 18) have it: 'complementary currencies […] are not intended to be compatible with speculation […] they are connected with a more or less radical reduction of their function as a store of value, i.e. as a financial asset.' RipplePay's implementation Villages.io most clearly performs this imaginary. This worldwide time bank tries to achieve social justice by anchoring its unit of account to a decent minimum wage, and to avoid that unit to be exchanged speculatively for arbitrage: 'a Village Hour is not a speculative unit, it's equal to a sustainable hour of wage in your community, so in each community [its value] is very different'[3]. After the acquisition of Fugger's project by Ripple, this culture persisted through experiments such as the LETS-inspired currency Goodwill (GWD), started by one of the earliest Ripple employees (Ripple Forum 2013). However, after the pivot of Ripple towards financial institutions in 2015, many of LETS enthusiasts abandoned the project, as the last sub-section shows.

The second culture emphasizes the liquidity of XRP as a means of payment and as a speculative cryptoasset, and it is a variation of digital metallism. Maurer et al. (2013, p. 263) define digital metallism as a culture in which 'trust in the code substitutes for the […] credibility of persons, institutions, and governments'. Ripple's variant of digital metallism foregrounds XRP's liquidity as a commodity: XRP is compared to gold not as a substitute for interpersonal trust, but as the most liquid of assets in terms of speed, value and exchangeability. The XRP Ledger is marketized for its speed, measured in 1,500 Transactions Per Second (TPS) compared to Ethereum's 15 and Bitcoin's 6 (Ripple 2019). Furthermore, this money culture foregrounds XRP's capability of automatically bridging between currencies through the distributed currency exchange built in the XRP Ledger.

However, as Swartz (2018, p. 18) has it, every payment for someone is an act of arbitrage for someone else: liquidity is connected to value in terms of exchangeability of assets with cash. Hence, in order to work as a bridge asset, XRP requires a market and liquidity of its own, (Dallyn 2017). Adoption and market-making constitutes a chicken-and-egg problem for cryptoassets: people will not use an asset until a market has developed around it, and such market will not develop if people do not use the asset (Presthus and O'Malley 2017). Over time, Ripple tried different strategies to expand XRP's liquidity and eco-system. XRP was first distributed either freely, or as remuneration for developers who spotted errors in the code. In 2017 and 2018, however, XRP's price skyrocketed: from US$0.01 in March 2017, it surpassed US$3.2 in January 2018 (CoinMarketCap 2019b). Previous distribution strategies became unprofitable for Ripple, and XRP became more palatable as an investment. Hence, Ripple started distributing XRP through loans and sales to market makers and liquidity providers in the cryptocurrency exchange markets. In 2018, Ripple created the subsidiary Xpring, that distributes XRP to fund fintech companies that might expand XRP's ecosystem (Ripple 2018a).

Market-making often overlapped with community-making: in 2018, the XRP community adopted a new logo, which was launched at an invite-only community night featuring celebrities such as rap artist Snoop Dogg on 15 May 2018 (Ripple 2018b). Ripple also performed large-value, highly publicized charity donations. In March 2018, Ripple donated $ 29 million worth of XRP to the charitable crowdfunding platform DonorsChoose.org, which funded all projects advertised at that moment (Elkins 2018). Later the same year, actor and Ripple investor Ashton Kutcher donated $ 4 million worth of XRP to the comedy show host Ellen Degeneres's Wildlife Fund (Huddleston 2018).

The third imaginary foregrounds the logistics of money, by leveraging the similarities between liquidity on trust lines and FX offers over the XRP Ledger, and data packets over the Internet (Fugger 2008, Interledger 2018). By providing interoperability, seamless circulation, and payment automation or Straight-Through Processing (STP), the XRP Ledger promises to be the cornerstone of the 'Internet of Value' (Cf. Flichy 2008, Rambure and Nacamuli 2008, Pardo-Guerra 2019). As one informant put it, 'Ripple is not only a cryptocurrency: to me, that was the most boring part of it. It actually models the entire financial ecosystem'[4].

However, the XRP Ledger is not only an interoperability layer between payment systems: it is itself a payment system, with its standards, requirements, and rules. Frictionlessness decentralization and seamless circulation remain promises rather than realities: the logistical space is fraught with frictions, fictions, and conflicts (Pesch and Ishmaev 2019, Schneider 2019). Ripple's research team understood this paradox when it realized that 'the world will never agree on one Ledger', yet the XRP Ledger is itself a ledger (Thomas 2016, p. 13). To overcome this paradox, Ripple developed the open-source Interledger Protocol (ILP) that synchronizes separate ledgers without creating a separate ledger (Thomas and Schwartz 2016). The Ripple Ledger changed its name in the XRP Ledger to stress the importance of the XRP asset, further contributing to market-making efforts for XRP. Conversely, many of Ripple's technological solutions now rely on the Interledger Protocol, more than the XRP Ledger per se.

Money cultures are not mutually exclusive, they do not evolve in a vacuum, and their co-evolution is always power-ridden. As Star (1990, p. 52) has it, every metaphor and imaginary can 'heal or create, erase or violate, impose a voice or embody more than one voice.' The next section will reconstruct the evolutions and conflicts that traversed the XRP Ledger, and the changes they brought to its overall disposition.

## An ecology of monies

> John Maynard Keynes proposed a supranational currency […] Friedrich Hayek called for increased currency competition. […] The underlying conflict is technical not ideological. As with so many other historical problems, this currency conundrum seemed intractable until technology caught up with the theory. Ripple's distributed exchange is the 'electronic calculator' that Hayek dreamed of, but on a scale he could never have imagined. […] If a global currency is like the universal language Esperanto, then Ripple is like the 'Babel fish,' the universal translator of science-fiction, and, more recently, Google. (Ripple 2013)

The XRP Ledger is an ecology, like any other money infrastructure. This quote retrieved from Ripple's archived website shows that the XRP Ledger promised an ostensibly neutral medium (the calculator) to provide interoperability (universal translation) between apparently incompatible political designs of money (Keynes and Hayek). This is far from what happened: different money cultures did not develop peacefully alongside each other, but rather engaged in multiple conflicts on which active forms to promote and which to deprecate, and they were influenced by forces outside the XRP Ledger. As Star (1990, p. 52) has it, 'One person's scrap paper can be another's priceless formula; one person's career-building technological breakthrough can be another's means of destruction.'

The terms of trade between money cultures and between active forms got influenced by two elements: XRP's price and Ripple's pivot towards financial institutions. First, XRP is not just an asset, but a switch that modulates the XRP Ledger. To activate an account, open a trust line, and issue offers on the distributed currency exchange, everyone needs to hold reserves in XRP. This turns XRP into a battleground between competing interests. LETS supporters need XRP to be cheap to activate trust lines and to pay transaction fees. Traders want its price to be volatile to make higher margins through arbitrage. Payment providers want XRP's value to be stable, to mitigate the exchange rate risks associated with using it as bridge asset. Ripple's management had to reconcile these three tensions with the need for making a market for XRP: to reassure the market, Ripple froze 55 billion XRP in an account that automatically releases only 1 billion XRP a month (Garlinghouse 2017). Over time, the terms of trade favoured crypto traders over LETS communities, and these users drifted towards other projects such as Stellar, which uses a very similar source code,

but has lower reserve requirements (Stellar 2018), and the Trustline Network, implemented on Ethereum (Hees et al. 2017).

Second, Ripple influenced the disposition of the Ledger when the company pivoted towards cross-border payments in 2015. This pivot was due to both regulatory pressure and new market opportunities. By 2015, the only point of access to the XRP Ledger at that moment was through Ripple's web client. Ripple, however, did not want to control the XRP Ledger or manage the Ledger's users as customers, because the Ledger is officially open-source and permissionless: the company's mantra was 'we don't own the network, we don't have customers'[5]. In 2015, the Financial Crimes Enforcement Network (FinCEN) sued Ripple for failure to abide by the US Bank Secrecy Act regarding Know-Your-Customer (KYC) and Anti-Money Laundering (AML) (FinCEN 2015). The FinCEN concluded that Ripple was responsible for customer screening and onboarding. Ripple settled the lawsuit on the 5 of May 2015, by committing to an extensive KYC programme and by paying a sum of $ 700.000. Shortly after, Ripple applied and obtained a New York State 'Bitlicense' for institutional sales of the cryptoasset XRP. Ripple, then, pivoted towards financial institutions to partially outsource regulatory compliance: serving banks rather than individuals meant for Ripple to be able to rely on banks' compliance departments rather than on its own forces.

Simultaneously, by 2015, the whole payments industry was caught in the enchantment of blockchain disruption. Cross-border payments were considered particularly ripe, because they lack a centralized infrastructure operating at a global level, and they are riddled by intermediaries and sometimes outdated technology like SWIFT (Scott and Zachariadis 2013). Even central banks like the Bank of England, the Federal Reserve, and the Saudi Arabia Monetary Authority had collaboration with Ripple connected to domestic payments updating (Liu 2015, Bank of England 2017, Ripple 2018c). Ripple was also invited SWIFT's conference SIBOS from 2014 to 2016, and several senior executives spoke at Money2020 in 2018. In 2017, Ripple launched its own conference SWELL, with keynote speakers Ben Bernanke in 2017 and Bill Clinton in 2018. Ripple's Venture Capital funding rounds also mirror the payment industry's enchantment with blockchain technologies. Ripple received $93.6 million in 9 funding rounds between 2013 and 2017, including a $32 million Series A funding round led by Santander InnoVentures, the VC branch of Banco Standander, which later implemented Ripple's technology for retail cross-border payments (Banco Santander 2018, Crunchbase 2018). The rise of XRP's price also contributed to attracting the attention of financial institutions. As one informant put it, in late 2017 'Ripple was worth more than all but maybe twenty banks in the planet. And that made the phone ring!'[6]

The promise of a neutral medium, hence, remained just a promise: the changes in the imaginaries associated with the XRP Ledger also entailed a shift in the overall disposition of the XRP Ledger. This changed the distribution of power and resources among its users. Ripple's market-making efforts turned XRP mainly into an investment, sought after for its liquidity, while Ripple's technology solutions became more focused on the Interledger Protocol, providing smoother logistical management of payments. This came at the price of marginalizing, within the XRP Ledger community, of the mutualism originally embodied by RipplePay. Ripple's pivot towards financial institutions favoured the imaginaries of logistics and liquidity over trust. Several people in the RipplePay community grew disenchanted and left the project[7].

## Conclusions

The rails and pipelines of money are at the forefront of a battle that increasingly involves established players and legacy institutions. The size of expansion of fintech startups involved in payments is so big that it has been called a 'Cambrian Explosion' (Nelms et al. 2018). J.P. Morgan launched its interbank settlement cryptoasset in early 2019 (J.P. Morgan 2019), and Facebook launched its own cryptocurrency Libra in June 2019 (Libra 2019). Legacy infrastructures are also co-opting blockchain technologies into their systems in a less flamboyant way (Allison 2018, SWIFT 2018), as 'boring middleware' (DuPont 2019, p. 172). While blockchain technologies are often purported as radically new

'money machines' (Coeckelbergh 2015), they are receding from view and becoming entangled with legacy infrastructures.

Brekke (2018, p. 61) brilliantly captured this as a moment when 'the doors to the money-press have been flung open, and we have limited time before the police come running.' This paper takes her exhortation in another direction: the money-press is up for grabs not only politically but analytically. The wiring, plumbing, and engine of money as a socio-technical infrastructure are, for a short moment, on display. Capturing money conceptually is as essential as seizing it politically, and this paper contributes towards that aim.

This paper investigated the tensions traversing this industry by taking Ripple and its payment infrastructures as the space of coevolution of various active forms and imaginaries, interacting with each other across patterns of dependence and competition. Money is always material, yet money's thingness is but one aspect of money's materiality. Money's materiality is also always already infrastructural, entailing the system of records, accounts, addresses, and logistics, allowing money's circulation. Infrastructures are, moreover, political machines that exert power and harbour diverse ways of engagement and participatory cultures (Beer 2013). These ecologies are always potentially prone to slippage, dissolution, disassembling, reassembling, and reappropriation, dependence, competition, reinvention, reappropriation, and resistance. Blockchain technologies are neither embryonic forms of radically different societies and monetary systems, nor business as usual. Instead, they 'productively engage in and perform a plurality [of modes of finance], thus blurring the line between alternative and dominant, formal and informal, embedded and disembedded' (Maurer 2012, p. 415).

This opens three avenues for future research. First, payment systems such as SWIFT have received remarkably little scholarly research, despite their systemic importance (Scott and Zachariadis 2013, Dörry et al. 2018). The study of their active forms and cultures would be especially timely. Second, it becomes increasingly problematic to understand cryptocurrencies as a radically different form of money. Cryptocurrencies should be approached and conceptualized beyond any 'blockchain exceptionalism.' Third, a concern with the political economy entailed by design, deployment and funding of money and payment infrastructure is needed precisely at a point in time when these infrastructures are becoming ubiquitous (Bernards and Campbell-Verduyn 2019). If infrastructures become so when they recede from view, a focus on the power, control, and distributive effects of infrastructures are necessary to prevent these forms of power and exclusion from becoming a repressed 'technological unconscious' (Thrift 2004) of money.

## Notes

1. Ripple Gateways Version 1.1, p. 9. Retrieved on the archived version of the website www.ripple.com.
2. Personal email exchange with Ryan Fugger, 29 May 2018.
3. Confidential interview 19 June 2018.
4. Confidential interview, 15 May 2018.
5. Confidential interview 16 November 2018.
6. Confidential interview, 19 April 2019.
7. Confidential exchange over twitter, 25 September – 15 November 2018, interviews on 19 June 2018 and 1 April 2019.

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